U.S. Patent Application Serial No. 09/938,732

IN THE ABSTRACT:

Delete the current Abstract and replace therewith the attached substitute Abstract.

IN THE SPECIFICATION:

Amend the specification as follows:

Please replace the paragraph beginning at page 1, line 5 with the following rewritten paragraph:

a1

The present invention relates to an engine generator apparatus and a cogeneration system and more particularly, to an engine generator apparatus interconnecting with an electric power network or grid for private use generator or a small-sized cogeneration facility and a cogeneration system including the engine generator apparatus.

Please replace the paragraph beginning at page 1, line 13 with the following rewritten paragraph:

a2

Generator apparatuses for private use have widely been provided for emergency use in case of blackout or power failure. Recently, private use cogeneration type generator apparatuses which can be interconnected with electric power networks for improvement of the efficiency of operation are getting popular. Such a cogeneration type private use generator apparatus comprises a small generator driven by a gasoline engine or a gas engine fueled with gas fuel such as town gas.

a2 cont'd.

Please replace the paragraph beginning at page 1, line 22 with the following rewritten paragraph:

For smooth interconnection with an electric power network, the cogeneration type generator apparatus needs to comply with the guideline for technical requirements for interconnection (issued by the Ministry of Trade) which stipulates technical standards including a range of outputs of applicable power networks and protections for the power network in case of a ground fault or short-circuit. It is necessary to cancel the interconnection with the network when the operation fails to comply with the requirements of the guideline as is regarded as a fault. As the operation has been reset to comply with the requirements of the guideline, the interconnection to the power [system] network can be re-established.

Please replace the paragraph beginning at page 2, line 17 with the following rewritten paragraph:

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When the cogeneration system having such an exhaust gas purifying apparatus encounters a fault during its operation, it cancels the interconnection with the power network and then stops the engine, thereby producing the following drawback. For normal operation, the oxygen density sensor needs to have a temperature of substantially 400 °C. At every re-start operation of the engine, a warming up for raising the temperature of the oxygen density sensor from a lower level to the operable level where the sensor is activated is required. The frequent warming up operation causes a declination in the operational efficiency. Particularly, as the engine is stopped upon temporary cancellation of the interconnection with the re-interconnection within a short interval of time, the

a3 cont'd

operational efficiency will significantly be declined. Also, if a protection scheme is switched on to stop the engine at every cancellation of the interconnection, it may exert unwanted loads on the startup device or other components.

Please replace the paragraph beginning at page 3, line 16 with the following rewritten paragraph:

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An engine generator apparatus according to the present invention is provided for interconnecting an output of a generator driven by an engine with a power network, comprising, an oxygen density sensor provided on the engine for controlling the air-fuel ratio based on its output, a means for interconnecting the output of the power generator with the power network, when the oxygen density sensor becomes its activated state, a fault detecting means for detecting a fault in the interconnection with the power network, a means for canceling the interconnection with the power network when the fault detecting means detects a fault, and resuming the interconnection with the power network when the fault is removed; and a means for stopping the engine when the interconnection is canceled for a predetermined length of time due to the fault detection.

Please replace the paragraph beginning at page 4, line 5 with the following rewritten paragraph:

According to the above arrangement, the engine is not stopped but operated with no load even if the interconnection with the power network is canceled, provided that the interval from the cancellation to the re-interconnection is not longer than a particular length of time. The engine stop

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in response to every cancellation of the interconnection can successfully be eliminated. As a result, a warming up for activating the oxygen density sensor can be carried out at a lower frequency and the exertion of undesired loads on the startup device for the engine can be avoided.

Please replace the paragraph beginning at page 5, line 16 with the following rewritten paragraph:

a5

One embodiment of the present invention will be described in more detail referring to the relevant drawings. Fig. 1 is a block diagram of the engine generator apparatus. As shown, an engine operated generator 10 comprises an engine 11 and a generator 12. The generator 12 is driven by the engine 11 for generating an alternating current output responding to the number of revolutions. The generator 12 comprises a rotor joined to the engine 11 and a stator on which three phase windings are wound. The output terminal of the three phase windings is connected with an inverter unit 13. The inverter unit 13 converts the alternating current output of the generator 12 into an alternating current of the quality equivalent (in voltage, frequency, noise, and other factors) to that of the commercial power supply, then the output is connected to the commercial power network as timed in phase with the same of the network.

Please replace the paragraph beginning at page 6, line 6 with the following rewritten paragraph:

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More specifically, the inverter unit 13 comprises a converter 131 for converting the alternating current output of the generator 12 into a direct current, an inverter circuit 133 for

a6 cnt'd.

converting the direct current received from the converter 131 into an alternating current with the frequency and the voltage of the commercial power network, a filter circuit 134, and a connector relay 135. The alternating current output of the inverter unit 13 is connected by the connector relay 135 and a main switch 136 to the commercial power network 14 and also to a domestic electrical load 15 (for example, in a private use power network).

Please replace the paragraph beginning at page 6, line 25 with the following rewritten paragraph:

a7

The system protector 138 monitors the voltage and frequency of the output of the generator 12 and if the voltage or the frequency is different from the reference level or the failure of the power supply is occurred, generates and supplies an error signal to the inverter controller 137 which in turn open the connector relay 135 thus release the parallel operation to protect the network. Failure in the power supply may be judged from jumping in the phase of the network. Alternatively, while the inverter output is periodically shifted in the phase, the failure may be judged from a degree of phase shift. The inverter controller 137 includes a nonvolatile memory such as an EEPROM for storage of data of the failure and data of the (unusual) stop motion when the failure takes place in the inverter unit 13 or the commercial power network 14.

Please replace the paragraph beginning at page 8, line 5 with the following rewritten paragraph:

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A communications unit 139 is provided between the ECU 38 and a combination (which may

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be referred to as an inverter side opposite to the ECU side) of the inverter controller 137 and the network protector 138 for communication of each state of both sides. A power source 140 is connected to the output terminal of the inverter unit 13 for supplying power to a drive source and a control source for both the engine generator 10 and the inverter unit 13.

Please replace the paragraph beginning at page 10, line 7 with the following rewritten paragraph:

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It is then examined at Step S3 whether or not a heat request is received or not from a controller (Fig. 5) for detecting the size of thermal load, i.e., the command for starting up the engine 11 is received. The thermal load in the form of a hot-water tank and the controller will be explained later in more detail.

Please replace the paragraph beginning at page 10, line 13 with the following rewritten paragraph:

When the heat request is received, the procedure goes to Step S6 where it is examined whether or not the engine 11 has a fault. If not, the procedure advances to Step S7 where the communication unit 139 is activated for inquiring of the inverter controller 137 about the state of the inverter unit 13. It is examined from a response from the inverter controller 137 at Step S8 whether or not the inverter unit 13 has a fault. If the inverter unit has no fault, the procedure goes to Step S9 for starting the engine 11. When the engine 11 is started up, its start is communicated to the inverter controller 137 through the communication unit 139.

Please replace the paragraph beginning at page 11, line 8 with the following rewritten paragraph:

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The process in the inverter controller 137 will now be explained referring to Fig. 3. As the main switch 136 has been turned on, it is examined from the data in the nonvolatile memory at Step S12 whether or not a power failure is detected. When the power failure is detected, the procedure goes to Step S13 for hesitation or time lag. After the hesitation of a predetermined length of time (e.g., 150 seconds), the procedure goes to Step S14. If no power failure is detected, the procedure jumps to Step S14 from Step S12.

Please replace the paragraph beginning at page 12, line 3 with the following rewritten paragraph:

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It is then examined at Step S14 whether the power network has a fault. If the power network has not fault, the procedure goes to Step S15 where it is examined whether or not the inverter unit 13 now has a fault. If there is no fault, the procedure moves to Step S17 for starting the checkup of the generator 12. When the inverter unit 13 has a fault, the procedure goes to Step S18 for storing a memory with a data of "inverter fault" and returns back to Step S14.

Please replace the paragraph beginning at page 12, line 12 with the following rewritten paragraph:

When it is judged at Step S14 that the power network has a fault, the judgment at Step S14 is maintained until the fault on the power network is eliminated. The data in the nonvolatile memory

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indicative of the fault of the inverter unit 13 is cleared when the user cancels the usual state and the judgment at Step S5 is affirmative. As a result, the inverter fault is eliminated. This information about the inverter unit 13 is transferred to the ECU 38 side as a response to the requiring at Step S7.

Please replace the paragraph beginning at page 12, line 21 with the following rewritten paragraph:

It is then examined at Step S19 whether or not the direct current voltage Vdc after the rectification process exceeds a predetermined level (e.g., 380 V). When the voltage exceeds the predetermined level, the procedure advances to Step S20 where the connector relay 135 is closed by the signal of "inverter start permission" transmitted at Step S1 for starting the parallel operation with the commercial power network.

Please replace the paragraph beginning at page 13, line 17 with the following rewritten paragraph:

a12

On the other hand, when the direct current voltage Vdc is less than the predetermined level after increasing the output of the inverter unit 13 with the output which is lower than the rated level ("negative" at Step S23), the procedure moves from Step S22 to Step S24. It is examined at Step S24 whether or not the judgment that the direct current voltage Vdc is not higher than the predetermined level is repeated at a predetermined number of times (e.g., five times). If Step S24 is affirmative, it is judged that the generator 12 has a fault and the parallel operation with the commercial power network is canceled thus stopping the inverter controlling process. If it is judged

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"not" at Step S24, the procedure goes to Step S25 for canceling the parallel operation. After providing a time lag at Step S26 for the predetermined length of time (150 seconds), the procedure goes back to Step S20 for re-starting of the parallel operation. The procedure may be shifted from Step S26 to Step S19 instead of S20.

Please replace the paragraph beginning at page 14, line 9 with the following rewritten paragraph:

When it is judged negative at Step S19, the procedure goes to Step S27 where it is examined whether or not the direct current voltage Vdc is below the predetermined level throughout a predetermined length of time (e.g., three minutes). When the generator 12 has a fault, it is judged affirmative at Step S27 or affirmative at Step S24, and the procedure goes to Step S24a. At Step S24a, the nonvolatile memory is stored with the fault of the generator 12 and then the inverter control procedure is terminated.

Please replace the paragraph beginning at page 15, line 19 with the following rewritten paragraph:

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If the fault signal is not received from the inverter unit 13, the procedure goes to Step S38 where it is examined whether or not a signal indicative of power system fault is received or not from the inverter controller 137. When the power network fault signal is not received, the procedure moves to Step S30. When the signal indicative of power system fault is received, the procedure moves to Step S39 for stopping the engine 11 and the procedure returns to Step S3.

a13 cont.

Please replace the paragraph beginning at page 16, line 2 with the following rewritten paragraph:

The process of the inverter controller 13 will now be explained referring to Fig. 5. It is examined at Step S40 whether or not the heat request off is received from the ECU 38. When the heat request off is received, the connection to the power network is released at Step S41 and the procedure moves back to Step S12 (Fig. 3). When the heat request off is not received, the procedure advances to Step S42 where it is examined whether or not the signal of the engine stop is received. When signal of the engine stop is received, the parallel operation is released at Step S43 and the procedure returns to Step S12. If the signal of the engine stop is not received, it is examined at Step S44 whether or not the inverter unit 13 has a fault. When the unit 13 has a fault, the procedure goes to Step S45 for releasing the connection to the commercial power network and the procedure moves back to Step S12.

Please replace the paragraph beginning at page 16, line 18 with the following rewritten paragraph:

If the inverter unit 13 has no fault, it is then examined at Step S46 whether or not the power system has a fault. When the power system has no fault, the procedure goes to Step S47 where it is examined whether or not the connection or parallel operation is established. When the parallel operation is established, the procedure returns back to Step S40.

Please replace the paragraph beginning at page 16, line 25 with the following rewritten

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paragraph:

a13 When it is judged at Step S46 that the power [system] network has a fault, the procedure goes to Step S51 for releasing the parallel operation of the systems. It is then examined at Step S52 whether or not a power failure occurs. When the power failure is detected, the nonvolatile memory is stored with the data indicative of the detection of the failure at Step S53. If no power failure is detected, the procedure skips Step S53 and jumps to the Step S54. It is then examined at Step S54 whether or not the power network fault continues throughout a predetermined length of time (e.g. five minutes). If Step S54 is negative, the procedure goes to Step S47. When the parallel operation is not established, the procedure advances to Step S48 where it is examined whether or not the power network has a fault. When the power network has a fault, the procedure moves back to Step S40. If not, the procedure goes to Step S49 for providing a time lag of a predetermined length of time (e.g., 150 seconds) and then to Step S50. At Step S50, the parallel operation is started. When the fault continues over the predetermined length of time, the procedure goes to Step S55 where the command of stopping the engine 11 is transmitted to the ECU 38. It is then examined at Step S56 whether or not the power network has a fault. When the fault has been eliminated, the procedure goes to Step S57 for providing a time lag of a predetermined length of time (e.g., 150 seconds) and then returned to Step S12 (Fig. 3).

Please replace the paragraph beginning at page 20, line 10 with the following rewritten paragraph:

a14 In response to the temperature information TI, the controller 29 controls the start and stop

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operation of the engine 11. Because the temperature information TI represents the demand of heat from the hot water supply unit 21 which draws the hot water directly from the hot water storage tank 17 or from the heating system 24 which draws the hot water indirectly via the second heat exchanger 22, the controller 29 judges that the demand exceeds when the temperature information TI is not higher than a reference level Tref-1 and drives the engine 11 to generate the heat. On the other hand, when the temperature information TI is higher than the reference level Tref-1, the controller 29 judges that a sufficient level of the heat energy is saved in the hot water storage tank 17 and turns the heat request off then stops the engine 11.

Please replace the paragraph beginning at page 20, line 25 with the following rewritten paragraph:

The reference level Tref-1 of the temperature is determined from multiple parameters of the type and the magnitude of the thermal load (i.e. the type and the capacity of the hot water supply unit 21 and the heating system 24), the thermal output of the engine operated generator 10, the volume of the hot water storage tank 17, and so on. The reference level Tref-1 has a hysteresis for ensuring a stable operation of the engine 11, i.e., avoiding frequent start and stop operations.

Please replace the paragraph beginning at page 21, line 22 with the following rewritten paragraph:

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The temperature of the hot water in the hot water storage tank 17 is significantly varied depending on the consumption of the hot water, i.e., the demand of thermal energy, and the mode

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of the operation of the engine operated generator 10, e.g., either the constant output mode or the electrical load dependent mode. For example, in a system where when the consumption of the hot water is low, the temperature of the hot water can be maintained to about 80 °C with the generator 12 operating in response to the temperature detected by the temperature sensor TS1, either abrupt, bulky consumption of the hot water resulting from the demand of heat given simultaneously from both the hot water supply unit 21 and the heating system 24 or the startup of the system may cause the temperature of the hot water in the hot water storage tank 17 to drop down to as a low degree as of the cool water supplied.

Please replace the paragraph beginning at page 24, line 17 with the following rewritten paragraph:

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As set forth above, the features of the present invention allow the engine to continue its motion even if the interconnection is canceled and resumed within a short interval of time, thus minimizing loads exerted on the startup device. Also, as the warming up for activating the oxygen density sensor which is always carried out after the engine is stopped has to be performed at less frequencies, hence avoiding declination in the operational efficiency.

Please replace the paragraph beginning at page 24, line 26 with the following rewritten paragraph:

According to the feature of the present invention, the engine is started in response to a heat request received from the waste heat utilizing means, thus permitting the waste heat produced during